15-16-17 SEPTEMBER 2024

INTERNATIONAL WORK GROUP FOR PALAEOETHNOBOTANY *RESEARCH GROUP*

PLANT MANAGEMENT AND DOMESTICATION IN SOUTHWEST ASIA

First Meeting

ARANZADI SCIENCE SOCIETY
Salón de Actos/Salón Elosegui
Zorroagagaina 11, Donostia-San Sebastian (Basque Country, Spain)

BUILDING COMMON GROUND ON CONCEPTS, DATA AND INTERPRETATION

European Research Council
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PALAEORIGINS
ikerbasque Basque Foundation for Science
Universidad del País Vasco
Euskal Herriko Unibertsitatea

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INTERNATIONAL WORK GROUP FOR PALAEOETHNOBOTANY

RESEARCH GROUP

"Plant management and domestication in Southwest Asia"

The research group provides a platform for investigating, discussing and promoting a better understanding of the origins and development of plant management and domestication in southwest Asia (broadly defined as the area commonly referred to as the Fertile Crescent and adjacent regions). Evidence for such processes may derive from different periods, including the Epipalaeolithic, Neolithic, Chalcolithic and Bronze Age. Methodologically, the research group focuses on macro- and microbotanical remains, including (but not limited to) carpology, anthracology, aDNA, phytoliths, starch grains and stable isotopes.

We also foster communication within and beyond the research community. This can involve sharing preliminary results, communicating novel approaches and concepts, and discussing methodological challenges.

To support these activities, the research group aims to organise regular meetings and workshops, which also provide an opportunity for networking and skills development, especially for students and early career researchers.

The idea for this research group emerged during the Symposium "Plant exploitation and management during the emergence of farming in southwest Asia: recent insights and new approaches" organised by Jade Whitlam and Alex Weide (then both at the School of Archaeology, University of Oxford) and, due to the pandemic, held over two online meetings in 2020 and 2021. A group of early career researchers then liaised with the IWGP to formally set up the research group, which included Amaia Arranz-Otaegui, Chiara Belli, Carolyne Douché, Müge Ergun, Ceren Kabukcu, Monica Ramsey, Alex Weide and Jade Whitlam.

AIM OF THE FIRST MEETING

In this meeting, researchers working around the world will convene to offer state-of-the-art perspectives and share new data on plant management and domestication in southwest Asia. We expect this first gathering to serve as a meeting point, to stimulate dialogue and discussion between researchers and set the foundations for future research.

COORDINATORS

Amaia Arranz-Otaegui, Alexander Weide, Jade Whitlam

MEMBERSHIP

To join the group and receive announcements, please sign up to our mailing list:
www.jiscmail.ac.uk/IWGP-SWA-PLANTDOM

ORGANISATION

IWGP RESEARCH GROUP COORDINATORS

Amaia Arranz-Otaegui (University of the Basque Country)
Jade Whitlam (University of Oxford)
Alex Weide (University of Cambridge)

LOCAL ORGANISING COMMITEE

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ARANZADI SCIENCE SOCIETY
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www.aranzadi.eus

FUNDING BODIES
ERC- Starting Grant agreement N°: 101039060 (PALAEORIGINS)

VENUE
How to reach

ARANZADI SCIENCE SOCIETY (Salón de actos/Salón Elosegi)
Zorroagagaina Kalea, 11, 20014 Donostia, Gipuzkoa

Buses from Donostia/San Sebastian to Aranzadi
15-20 minutes from the city center

- **LINE 17** - Info and route map
- **LINE 28** - Info and route map
- **LINE 31** - Info and route map
- **LINE 37** - Info and route map

BUS STOPS (from the city center)
Begiristain 1 (lines 17/28/31)
Zorroagako 1 (line 37)

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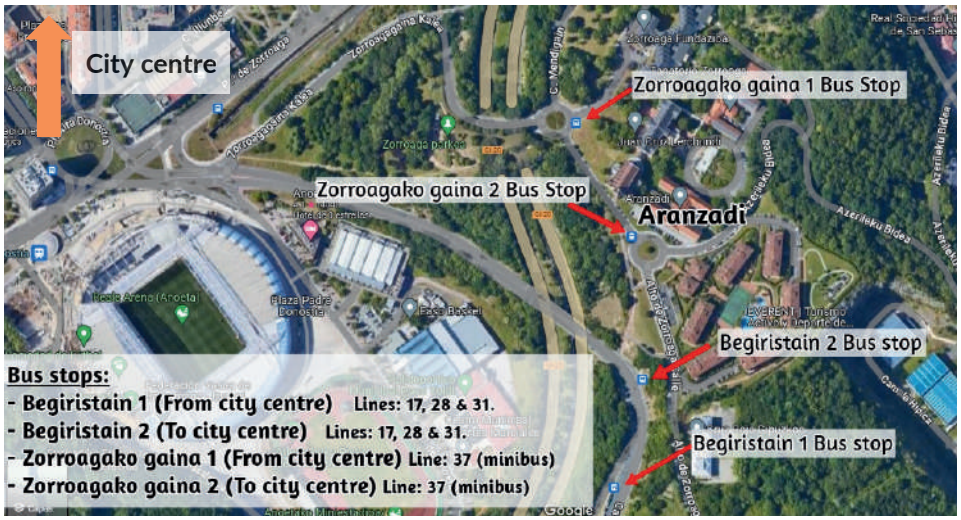

City bus line: www.dbus.eus

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TOURIST CITY CARD
online (San Sebastian City Card)
in the Tourist Office and in some hotels

SIX D-BUS TRIPS 9€
TWELVE D-BUS TRIPS 16€

The TOURIST CITY CARD includes several other discounts in museums, restaurants, other transport and leisure activities (Activities San Sebastian Card)

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PROGRAMME

SEPTEMBER 15TH SUNDAY

- 14.00-15.00 Registration
- 15.00-15.15 Welcome to the Society of Sciences Aranzadi

SESSION 1: Key terms and new hypothesis on the origins of plant management and domestication

Chair: Alex Weide

- 15.15-15.30 Amaia Arranz-Otaegui, Barbara Proserpio, Jon Aldaia and Marc Cárdenas "*The Epipalaeolithic origins of plant management in Southwest Asia*".
- 15.30-15.45 Dorian Fuller, Leilani Lucas, Chris Stevens and Robin Allaby "*Hotspots and temporal episodes in domestication processes of West Asian crops*".
- 15.45-16.00 Shahal Abbo and Avi Gopher "*Resolution, terminology and their bearing on modelling Near Eastern plant domestication*".
- 16.00-16.15 Questions.

- 16.15-16:30 Ehud Weiss "*Pre-domestication cultivation in the Fertile Crescent – annuals and perennials*".
- 16.30-16.45 Leilani Lucas, Chris Stevens and Dorian Fuller "*Morphological domestication for individual West Asian crops: evidence, gaps and economic importance*".
- 16.45-17.00 Dafna Langgut "*The core area of fruit-tree cultivation: Central Jordan Valley (Levant), ca. 7,000 BP*".
- 17.00-17.15 Questions.

17.15-17.30 Brief break and group photo

17.30-18.30 Keynote Speakers:

- Eneko Iriarte (Associate Professor, Dept. of History, Geography and Communication, University of Burgos) "*Basque(s)... in search of their origins: the latest archaeological evidence*".
- Aitzpea Leizaola (Associate Professor, Dept. of Philosophy of Values and Social Anthropology, University of the Basque Country, UPV-EHU) "*Basque food: a matter of nutrition, creation and consumption*".

18.30-20.00 Welcome drinks and plant-based cocktails

PROGRAMME

SEPTEMBER 16TH MONDAY

SESSION 2: New archaeobotanical evidence for the Palaeolithic and Neolithic in Southwest Asia

Chair: Jade Withlam

- 9.00-9.15 Barbara Proserpio, Jon Aldaia, Marc Cárdenas, Dorian Q. Fuller, Amaia Arranz-Otaegui "*Evolution of Natufian plant exploitation practices at Shubayqa 1 (Black desert of Jordan)*".
- 9.15-9.30 Jon Aldaia, Amaia Arranz-Otaegui *"Anthracological study of Natufian palaeoenvironments in the Black Desert"*.
- 9.30-9.45 Carolyne Douché, Amaia Arranz-Otaegui, Andrea Zupancich, Yoel Melamed, Juan José Ibáñez "*Plant exploitation during the PPN: focus on legumes at Kharaysin (Jordan)"*.
- 9.45-10.00 Questions.

- 10.00-10.15 Müge Ergun "*Recent evidence, thoughts and questions for plant management and domestication at the onset of agriculture in volcanic Cappadocia, Central Anatolia*".
- 10.15-10.30 Ceren Kabukcu "*Investigating pulse domestication in Southwest Asia: challenges and prospects*".
- 10.30-10.45 Hanna Caroe "'*People look east': evidence from plant remains for transmission of Neolithic lifeways eastwards from the Zagros"*.
- 10.45-11.00 Questions.

- **11.00-11.15 Poster Session**
  - 3 min. Flash talk. Andoni Mateos, Josu Aranbarri, Eneko Iriarte, Amaia Arranz-Otaegui, Juan Muñiz, Juan José Ibáñez *"Mediterranean deciduous oak woodland opening during the 9th millennium cal BC levels at Kharaysin, Jordan: human-driven or response to climate?"*.
  - 3 min. Flash talk. Michal David and Yoel Melamed *"Impact of morphological changes during preservation on seed and fruit identification"*.
  - 3 min. Flash talk. Alicia Gómez-Fernández *"Elucidating the ecological strategies of crop wild progenitors through trait-based plant ecology"*.
  - Questions.

11.15-11.45 Coffee Break

SEPTEMBER 16TH MONDAY

Chair: Amaia Arranz-Otaegui

- 11.45-12.00 Lachlan Kyle-Robinson and Monica Ramsey *"Resiliency: Pre-Pottery Neolithic plant use resource selection during regional decline"*.
- 12.00-12.15 Andrew Fairbairn and Adnan Baysal *"Archaeobotany at Canhasan I and III: retrospect and prospect"*.
- 12.15-12.30 Questions.

SESSION 3: Plant foods and foodways in the Epipalaeolithic-Neolithic transition

Chair: Amaia Arranz-Otaegui

- 12.30-12.45 Marc Cárdenas, Barbara Proserpio, Tobias Richter, Amaia Arranz-Otaegui *"Evaluating the Natufian plant food spectrum at Shubayqa 1, Jordan"*.
- 12.45-13.00 Andrea Zupancich, Emanuela Cristiani, Avi Gopher, Juan José Ibañez *"On the significance of plant foods in the daily life of the first neolithic farmers: ground stone tools and ancient dental calculus reveal insights into cereal and legume consumption strategies during the Pre Pottery Neolithic of the Southern Levant"*.
- 13.00-13.15 Hussein Madina, *"What can the Frikeh tell the archaeobotanist?"*.
- 13.15-13.30 Questions.

13.30-15.00 Lunch Break - Xanti restaurant (Anoeta Hotel)

SESSION 4: Genetic and ecological consideration on crop domestication

Chair: Dorian Q. Fuller

- 15.00-15.15 Laura Botigué *"Genomic insights into wheat domestication"*.
- 15.15-15.30 Hugo Oliveira, Rui Machado, Bernardo Ordás Lopez *"West side story? The possibility of independent prehistoric crop domestication in the western Europe"*.
- 15.30-15.45 Lev Mirom, Nimrod Ashkenazy, Valentyna Klymiuk, Jennifer Enns, Krysta Wiebe, Verena J. Schuenemann, Bar A. Lavi, Torsten Günther, Tamar Krugman, Hanan Sela, Eitan Klein, Amir Ganor, Uri Davidovich, Roi Porat, Erez Ben-Yosef, Sivan Frankin, Roi Ben David, Abraham Korol, Martin Mascher, Axel Himmelbach, Nils Stein, Johannes Krause, Assaf Distelfeld, Ehud Weiss, Tzion Fahima, Curtis J. Pozniak, Sariel Hübner, *"Ancient grains from desert caves illuminate the domestication saga of wheat"*.
- 15.45-16.00 Questions.

PROGRAMME

SEPTEMBER 16TH MONDAY

Chair: Carolyn Douché

- 16.00-16.15 Rubén Milla Gutiérrez *"Evolution of crops: insights from ecological research"*.
- 16.15-16.30 Chris Stevens, Leilani Lucas, Dorian Fuller *"Evolving weeds and arable ecosystems: three approaches to early weeds"*.
- 16.30-16.45 Alexander Weide, John G. Hodgson, Ramon Buxo, Carolyne Douché, Amy Bogaard *"Ecological processes in Levantine grassland and arable fields, and how they can help to understand early plant management practices"*.
- 16.45-17.00 Questions.

17.00-17.30 Coffee Break

- 17.00-17.15 Jade Whitlam, Pascal Flohr, Amy Bogaard, Mike Charles, BIll Finlayson, Cheryl A. Makarewicz *"Developmental plasticity and genetic selection shaped cereal evolution in the early Holocene southern Levant"*.
- 17.15-17.30 Jose Luis Araus, Maria Dolors Serret, Barbara Proserpio, Haizea Irastorza, Amaia Arranz-Otaegui *"The transition to the Neolithic: identifying growing conditions of cereals at Shubayqa 1 and 6 (northeastern Jordan) and Qarassa North (Sweida, Syria)"*.
- 17.30-17.45 Yixiang Shan and Colin Osborne *"How did domestication change wheat morphology and competitiveness?"*.
- 17.45-18.00 Questions.

- **18.30-19.00 Optional tour to visit the reference collection housed in Aranzadi**

  The Fungi collection
  The Animal Bone collection
  The Botany collection

- **18.30-20.00 Lab time**

PROGRAMME

SEPTEMBER 17TH TUESDAY

ROUND TABLE

- **9.00-9.15 Introduction and discussion rules**

- **9.15-11.00 SESSION 1 - Terminology: Defining key concepts**

Moderator: Amy Bogaard

AIM: 1) To achieve common definitions of key concepts related to plant management and domestication in southwest Asia, which will serve as a reference point for future discussions and research within the community.

11.00-11.30 Coffee Break

- **11.30-13.30 SESSION 2 - The identification criteria to recognize plant management, domestication and types of subsistence in the archaeological record**

Moderator: Mark Nesbitt

AIM: 1) To build common ground on the identification criteria used to recognise key concepts in the archaeological record. 2) To discuss potentials and limitations of each of the methods used. 3) To highlight potential areas of disagreement that are based on empirical evidence.

13.30-15.30 Lunch Break - Xanti restaurant (Anoeta Hotel)

- **15.30-17.30 SESSION 3: Current gaps and future prospects on the origins of agriculture in southwest Asia**

Moderator: Amy Boogard and Mark Nesbitt

AIM: Taken together the definitions and the identification criteria agreed upon, we seek to identify gaps in our current evidence for plant management and domestication in southwest Asia and define priorities for future research.

17.30-18.00 Coffee Break

- **18.00 FINAL REMARKS**

ABSTRACTS

SESSION 1: Key terms and new hypothesis on the origins of plant management and domestication

1.The Epipalaeolithic origins of plant mangement in Southwest Asia

Amaia Arranz-Otaegui (1,2), Barbara Proserpio (1), Jon Aldaia (1,2), Marc Cárdenas (1)

(1) University of the Basque Country; (2) Society of Sciences Aranzadi

The transition from foraging to farming represents one of the most transcendental shifts in the history of humanity. Decades of research in southwest Asia have shown that this process culminated with the development of Neolithic agricultural systems c. 10 ka cal. BP. Yet how it started, that is, how hunter-gatherers became, for the first time, engaged with the management of plants, continues to be largely undetermined. In this presentation we will provide an overview of what we know and what we do not know about the early stages of this fundamental transition. We focus on the Epipalaeolithic period (23-11.6 ka cal. BP) of the Levant and present a database that expands our previous compilations and includes non-woody plants, wood charcoal remains, and phytolith and starch studies for a total of 43 sites in the area. Based on this data, we reflect on the plant exploitation strategies adopted during the Epipalaeolithic period and the main changes that were documented over time. In particular, we highlight shifts in the plant-based diet and food choices, as well as discuss the potential evidence for plant management. We conclude the presentation emphasizing some of the research biases and limitations we face in the study of the Epipaleolithic period, and suggesting lines of study that could be included in the research agenda for the transition to food production in southwest Asia.

ABSTRACTS

SESSION 1: Key terms and new hypothesis on the origins of plant management and domestication

2. Hotspots and temporal episodes in domestication processes of West Asian crops

Dorian Q. Fuller (1), Leilani Lucas (2), Chris Stevens (1), Robin Allaby (3)

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The growth of empirical archaeobotanical data has highlighted that domestication processes in cereals were spread out over both time (millennia) and space (100,000s rather than 10,000s of sq. km.). This means that evolution processes cannot be assumed to be fixed in a single sub-region or occur at a constant rate, despite previous estimates relying on an averaged rate for each crop (e.g. Purugganan and Fuller 2011). Updated data from West Asian cereals, pulses, and flax are analyzed in terms of quantifying varying rates of change (Haldane rates) for each crop through time for both seed size and cereal shattering. This identifies sub-episodes key to the quantification of amounts of change and rates of change in cereal non-shattering and/or seed size increase, flax and pulse seed size change. These rapid sub-episodes can be compared chronologically across crops and mapped geographically, identifying those periods and regions which are implicated in having the highest selection pressures in terms of domestication. Other regions and periods were less involved in exerting selection for domestication. This raises key questions about which cultural practices and ecological conditions may be regarded as contributory to domestication. This provides a first map that approximates the mosaic of West Asian Neolithic cultural zones, highlighting those with greater domesticatory tendencies in their cultural traditions.

ABSTRACTS

SESSION 1: Key terms and new hypothesis on the origins of plant management and domestication

3. Resolution, terminology and their bearing on modelling Near Eastern plant domestication

Shahal Abbo (1) and Avi Gopher (2)

(1) The Hebrew University of Jerusalem; (2) Tel Aviv University

The struggle to achieve the highest resolution possible is common to all sciences, Archaeology, Archaeobotany and Evolution included. The terms used in each discipline reflect this struggle and the frameworks of thought held by the involved.
Plant domestication research in the Near East tends to involve some inherent incompatibilities between the resolution of the data, the basic assumptions made while modeling it and the domestication models offered. This paper will discuss the nature of the evidence and the resolution power and predictive potential of this evidence for plant domestication modeling. We will point out some examples and briefly discuss their bearing on modeling plant domestication in the Near East and the potential of such models to distinguish plant domestication from crop evolution under domestication. Plant domestication and crop evolution under domestication are highlighted and we offer that their distinction as a possible resolution-promoting element may offer answers to some of the present disagreements in plant domestication research in the Near East.

ABSTRACTS

SESSION 1: Key terms and new hypothesis on the origins of plant management and domestication

4. Pre-domestication cultivation in the Fertile Crescent – annuals and perennials

Ehud Weiss (1)

(1) Bar Ilan University

As the debate on the 'what-when-where' of the agricultural origins in the Fertile Crescent continues, a less-explored aspect of 'pre-domestication cultivation' has emerged. Over time, our understanding has been enriched with a wealth of new data. This includes two significant research avenues: (i) detailed archaeobotanical information, spanning seeds, fruits, pollen, and wood, from meticulously analyzed archaeobotanical assemblages, and (ii) ancient DNA research, which has leveraged the global advancements in computer science (both hardware, software, and bioinformatics), as well as the continuous improvements in sequencing machines and the reduction in sequencing costs.
In this lecture, I will present this cadre of new data to redraw the entangled situation during our ancestors' transition from a hunting and gathering lifestyle to a combined economy of gathering and cultivation. This transition, as our data indicate, was a complex and multifaceted process, successful in some cases while leading to a dead-end in others. The final shift of the PPNB was more than just a continuation of all previous pre-domestication events.

ABSTRACTS

SESSION 1: Key terms and new hypothesis on the origins of plant management and domestication

5. Morphological domestication for individual West Asian crops: evidence, gaps and economic importance

Leilani Lucas (1), Chris Stevens (2), Dorian Q. Fuller (2)

(1) College of Southern Nevada; (2) University Colledge of London

This paper reviews the state of the evidence documenting morphological changes across each of the early known crops of Southwest Asia: *Hordeum vulgare*, *Triticum diccocum*, *T. monococcum*, *T. timopheevii*, *Lens culinaris*, *Pisum sativum*, *Cicer arietinum*, *Vicia faba*, *Vicia ervilia*, and *Linum usitatissimum*. We provide an update on the more limited data for five of these species available a decade ago (Fuller et al. 2014, PNAS) and consider each species individually. The paper examines the morphological data in time and space in relation to broader reporting of taxon presence and the quantitative importance of each taxon through time where available. While there is a trend towards increasing importance of each crop over time, there are divergent subregional patterns. There is more evidence for both increasing importance and morphological change outside the northern Levant and northern Fertile Crescent, suggesting that dispersal of cultivation from its earliest centres may play a role in increasing the importance of food production and reliance on domesticated forms. Most significant, however, is how limited the data on domestication processes are, as most taxa are limited to quantitative morphological data from only between 10 and 20 sites. Increasing these data to fill in gaps across time and space should be a priority, and some of this can be achieved through examining existing samples.

ABSTRACTS

SESSION 1: Key terms and new hypothesis on the origins of plant management and domestication

6. The core area of fruit-tree cultivation: Central Jordan Valley (Levant), ca. 7,000 BP

Dafna Langgut (1)

(1) Tel Aviv University

While it is widely accepted that the five main fruit trees that established horticulture in the late prehistoric period are: olive (*Olea europaea*), common fig (*Ficus carica*), grapevine (*Vitis vinifera*), date palm (*Phoenix dactylifera*), and pomegranate (*Punica granatum*), there is much less agreement on where, when, and why this happened. This study suggests that all five founders were first assembled into a package in one geographically small region - the Central Jordan Valley. From this core area, knowledge and/or genetic materials were shifted to nearby regions. Yet, it cannot be ruled out that other parallel independent domestications may have occurred in other regions. 14C dates from the central Jordan Valley indicate that the emergence of fruit tree horticulture is dated at ca. 7,000 years cal. BP., earlier than previously considered. The primary motivation seems to be related to political and socioeconomic considerations rather than climatological-environmental concerns or other factors. The paper will also discuss the cost-effective benefits of simultaneously cultivating several fruit trees.

ABSTRACTS

SESSION 2: New archaeobotanical evidence for the Palaeolithic and the Neolithic in Southwest Asia

1. Evolution of Natufian plant exploitation practices at Shubayqa 1 (Black Desert of Jordan)

Barbara Proserpio (1), Jon Aldaia (1,2), Marc Cárdenas (1), Dorian Q. Fuller (3), Amaia Arranz-Otaegui (1,2)

(1) University of the Basque Country; (2) Society of Sciences Aranzadi ; (3) University College London

Since the early twentieth century, the Natufian culture has been related to the transition from mobile hunter-gatherers to settled farming societies. The adoption of new subsistence practices must have played a part in this fundamental change in human social organisations. Nevertheless, the archaeobotanical information about Natufians' plant-based subsistence is still patchy.
In this presentation, we investigate the evolution of plant exploitation practices during the Natufian period in the Black Desert of Jordan, an arid area characterised by Saharo-Arabian vegetation. The aim is to understand how human groups adapted their subsistence strategies to late Pleistocene climatic fluctuations (e.g. Bölling-Alleröd, Younger Dryas) and cultural developments (Early Natufian – Late and Final Natufian), in this specific environment. For this purpose, we conducted taxonomic and taphonomic analyses on the non-woody plant macroremains of Shubayqa 1, a key site dated from the Early to the Late/Final Natufian (ca. 14.600-11,500 cal. BP).
The non-woody plant macroremains analysed show a general prevalence of small-seeded grasses, plants of the Cyperaceae and Brassicaceae families. Among the wild progenitors of the so-called "founder crops", we found wild barley and wild einkorn wheat. The presence of wild einkorn is significant, indicating that the natural distribution of this plant was wider than previously thought. The observed changes and continuities in the plant spectrum during the phases of occupation are evaluated in relation to the shift in the environmental conditions and cultural practices linked to the use and consumption of plants. Overall, the exceptional preservation of non-woody plant assemblage at Shubayqa 1 provides new insight into Natufian's plant exploitation strategy in the previously little-investigated Saharo-Arabian region. The future analyses of Shubayqa 6 will allow us to have a crucial sequence from the Early Natufian to the Pre-Pottery Neolithic A, unique to understanding the shift from foraging to farming during the late Pleistocene-early Holocene transition.

ABSTRACTS

SESSION 2: New archaeobotanical evidence for the Palaeolithic and the Neolithic in Southwest Asia

2. Anthracological study of Natufian palaeoenvironments in the Black Desert

Jon Aldaia (1,2), Amaia Arranz-Otaegui (1,2)

(1) University of the Basque Country; (2) Society of Sciences Aranzadi

The biotic landscape of Natufian settlements in desertic regions is poorly understood. Few palaeoenvironmental records register the changes in vegetation during a crucial period as it is the transition between the Bölling-Allerod and the Younger Dryas. Consequently, it becomes very difficult to trace a relationship between the possible short-term climatic changes affecting the region and the Natufian territory occupation and subsistence strategies.

Through the anthracological analysis of 3.800 fragments from the charcoal assemblage of Shubayqa I, we analysed the changes in woody-taxa availability between the Early and Late Natufian occupation phases in the Jordanian Black desert. Aiming to reconstruct the local arboreal and shrub landscape through time.

Our results indicate the main woody taxa in the assemblage is *Tamarix* sp., together with bushes and shrubs (*Vitex* sp., *Zilla* sp. and Chenopodiaceae) and occasional riparian taxa like Salicaceae. The sporadic presence of Irano-Turanian elements like *Pistacia* sp. and *Amygdalus* sp. is documented in archaeological contexts dated to the Late Natufian, but possible contamination issues are at present under evaluation. Although changes are noted in the abundance of these main taxa, no big differences are observed in the diversity and composition of the woody-taxa assemblage.

This new data offers a unique opportunity to characterise the impact of major climatic changes in the local availability of wood resources, essential to understand Natufian niche construction strategies in desertic environments.

ABSTRACTS

SESSION 2: New archaeobotanical evidence for the Palaeolithic and the Neolithic in Southwest Asia

3. Plant exploitation during the PPN: focus on legumes at Kharaysin (Jordan)

Carolyne Douché (1), Amaia Arranz-Otaegui (2,3), Andrea Zupancich (4), Yoel Melamed (5), Juan-José Ibáñez (6)

(1) University of Oxford; (2) University of the Basque Country; (3) Society of Sciences Aranzadi; (4) Sapienza University of Rome; (5) Bar-Ilan University, Israel; (6) Spanish National Research Council, Milà i Fontanals Institute for Humanities Research

Excavation carried out since 2014 at the site of Kharaysin (Zarqa, Jordan) revealed an early Neolithic settlement, occupied between c. 9000 and 7500 cal BCE, encompassing cultural phases from the Late PPNA to the Middle PPNB. Several archaeological evidence such as architecture, flint industry, grinding-stones and animal remains document domestic activities linked to the food production and consumption. But what were the main characteristics of the plant diet? And how did it evolve through time in this village?
Archaeobotanical samples were collected in various contexts. Conversely to many PPN sites, the main components of the diet were legumes, and not cereals. Indeed, a wide range of pulses - including lentil, vetch, broad bean and chickpea – were identified. These results are consistent with those previously obtained at the contemporary sites of Tell el-Kerkh, Ahihud and Yiftah'el, where pulses recovered in storage facilities were dominating the crop assemblages. The present paper will explore the PPN subsistence economy at Kharaysin and the neighbouring areas.

ABSTRACTS

SESSION 2: New archaeobotanical evidence for the Palaeolithic and the Neolithic in Southwest Asia

4. Recent evidence, thoughts and questions for plant management and domestication at the onset of agriculture in volcanic Cappadocia, Central Anatolia

Müge Ergun (1)

(1) University of Oxford

Volcanic Cappadocia, one of the geographical regions for early agricultural lifeways in southwest Asia, yields important evidence to understand food production dynamics and processes that built the pathways to farming communities. This paper aims to highlight the-state-of-art by focusing on the carpological analyses of food plants from two aceramic Neolithic communities from volcanic Cappadocia.

The early sedentary communities of Aşıklı Höyük (8400-7350 cal. BCE) and the recently discovered Balıklı (c. 8250-7950 BCE), provide an unique opportunity to assess variability in plant management practices and domestication and the diverse foodways of early sedentary communities on a localscale.

While presenting the recent and accumulated evidence from both sites, this paper will also discuss the challenges concerning the analyses of these assemblages, and underline further thoughts, approaches and questions that might contribute to our understanding for the beginnings of agricultural and sedentary life in southwest Asia.

ABSTRACTS

SESSION 2: New archaeobotanical evidence for the Palaeolithic and the Neolithic in Southwest Asia

5. Investigating pulse domestication in Southwest Asia: challenges and prospects

Ceren Kabukcu (1) (2)

(1) University of Liverpool; (2) University of Algarve

Pulses represent a crucial element of diets worldwide today, and undoubtedly in the past, providing a significant source of plant-based proteins. They are also ubiquitously found in early Neolithic assemblages across Southwest Asia, but the investigation of their early management and domestication remains a challenge. This is due in part to the fact that markers of domestication clearly associated with shattering habit, or loss of dormancy, are rarely preserved in charred assemblages. This paper will review the evidence to date on various pulse progenitors from Southwest Asia aiming to highlight the likely prominence of a diverse range of pulses in Epipalaeolithic and early Neolithic subsistence practices. The overall aim of the paper is to discuss potential methods for the investigations of early management and cultivation of these taxa. Case studies from Southeast Anatolia dating to the Pre-Pottery Neoltihic will be presented which demonstrate the potential applicability of isotope analyses to characterise pulse habitats and changes in growth conditions, as well as the application of microCT scanning to investigate seed coat thickness.

ABSTRACTS

SESSION 2: New archaeobotanical evidence for the Palaeolithic and the Neolithic in Southwest Asia

6. People look east': evidence from plant remains for transmission of Neolithic lifeways eastwards from the Zagros

Hannah Caroe (1)

(1) University of Oxford

This paper presents research on the transmission of domesticated crop-types and Neolithic lifeways eastwards from the Zagros into Iran. Specifically, it aims to test tenets of what is here termed the 'two corridor hypothesis' (TCH). This suggests that, owing to geomorphological barriers across much of Iran (mountain ranges and desert areas), movement of people, animals, plants and ideas would have been funnelled along two natural corridors, to the north and south of the region respectively. To investigate the TCH, archaeobotanical assemblages from five Epipalaeolithic and Neolithic sites located on or close to the proposed routes for the corridors (Hotu, Kamarband and Komishani Tappeh on the Iranian Caspian shore in the north and Toll-e Sangi and Tappeh Poustchi in the south) are analysed, in conjunction with previously published archaeobotanical data from Iranian sites. Preliminary results indicate locally-specific trends in the adaptation of 'crop packages'. There is also evident reliance at some sites on crops that are not part of the canonical Neolithic 'founder crop package'. This ongoing project represents a unique opportunity to compare and contrast assemblages from parts of southwest Asia which have as-yet benefitted little from systematic archaeobotanical assessment.

ABSTRACTS

SESSION 2: New archaeobotanical evidence for the Palaeolithic and the Neolithic in Southwest Asia

7. Resiliency: Pre-Pottery Neolithic plant use and resource selection during regional decline

Lachlan Kyle-Robinson (1) and Monica Ramsey (1)

(1) University of Toronto

This paper will present the results from a recent phytolith analysis undertaken at the PPNB-PPNC transitionary site of Beisamoun, located within the Hula Valley of Northern Israel. The direct evidence of plant-use at the site is contextualized within published regional trends for shifts in technology, economy, social organization, and subsistence strategies characteristic of the late PPNB-PPNC transition. In particular, this presentation will explore the ecological and cultural resilience displayed by the inhabitants of Beisamoun in contrast to the social reorganization and flux seen at other PPNB mega sites in the Southern Levant. Emphasis will be placed on the utilization of wetland plant resources, which this paper argues is a form of ecological inheritance allowing the only known PPNB Mega-site west of the Jordan river to show remarkable continuity of material culture during the PPNB-PPNC transition. These findings contribute to a more nuanced understanding of how human-environment relationships mediated the regional decline and social restructuring associated with the PPNB-PPNC transition of the Southern Levant.

ABSTRACTS

SESSION 2: New archaeobotanical evidence for the Palaeolithic and the Neolithic in Southwest Asia

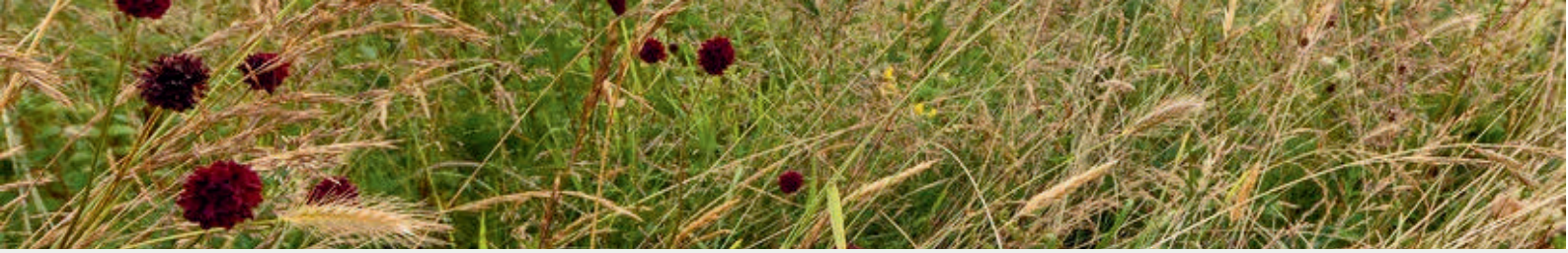
8. Archaeobotany at Canhasan I and III: retrospect and prospect

Andrew Fairbairn (1) and Adnan Baysal (2)

(1) The University of Queensland; (2) Ankara Üniversitesi

Excavation by David French at Canhasan on the Karaman alluvial fan in central Turkiye sampled settlement from the Aceramic Neolithic (pre 7500 cal BC) to Chalcolithic at least 5,500 cal BC). Spanning the 'flotation revolution', work at Canhasan I (1961-1968) saw no systematic sampling and processing, but Canhasan III included the first systematic trial of machine flotation in the Old World. Publication of the analysis has been interrupted by numerous factors, but demonstrates the presence of a cereal and pulse focused agricultural system, with possible move to the former from the latter by 7000 cal BC when the site is abandoned. Claims for the presence of domestic rye and naked wheat are questioned by recent re-dating and the assemblage is dominated by domestic 'New type' glume wheat, probably *Triticum timopheevi*, alongside emmer and einkorn, lentil and bitter vetch. Weed seed data is dominated by larger weed sizes and may be affected by biased recovery.

A new excavation is now re-sampling Canhasan III and will extend to Canhasan I and II, the latter a classical period site thus complementing and extending research on plant use and domestication histories to the north in the Konya Plain (Catalhoyuk, Boncuklu and Pinarbasi). Problems with the 1969-1970 dataset can be addressed, including the uncertain flotation mesh size and potential for cross-contamination of the samples. Bringing together GIS based landscape modelling, with new geoarchaeological, isotopic and climate research, provides the potential to finally resolve and extend the Canhasan botanical record and apply it to some of the wicked problems of our age. These include rewilding of a denuded and imperilled biota, but also technical capacity in archaeobotany, which will be addressed by on-site training for Turkish students, and public understanding of the site and our work, achieved through the development of on-site and online education.



ABSTRACTS

SESSION 3: Plant foods and foodways in the Epipalaeolithic-Neolithic transition

1. Evaluating the Natufian plant food spectrum at Shubayqa 1, Jordan

Marc Cárdenas (1), Barbara Proserpio (1), Tobias Richter (2), Amaia Arranz-Otaegui (1,3)

(1) University of the Basque Country; (2) University of Copenhague; (3) Society of Sciences Aranzadi

It has been argued that cereal-based food products played an important role in Epipalaeolithic hunter-gatherer communities and that this led to their cultivation for the first time. Consequently, culinary and dietary choices and food consumption are key factors in our understanding of the transition to early agriculture in Southwest Asia.
In the last decade, the discovery of carbonised remains from plant-based meals has provided empirical evidence for the study of prehistoric plant-food ingredients and foodstuffs (i.e.bread-like, beer-like products), yet the application of these methods to the Epipalaeolithicperiod (c. 20.000 – 11.600 cal. BP) is still limited.
To address this research gap we present the analysis of more than 100 charred plant-food remains from the Late Epipalaeolithic Natufian site of Shubayqa 1, in the Black Desert (Jordan). They provide a window into the use of plant ingredients, and the preparation of specific food types. We compare the results obtained with those resulting from the study of non-woody plant macroremains to assess the range of plants available in the area during the Final Pleistocene with those selected by people as food ingredients.

ABSTRACTS

SESSION 3: Plant foods and foodways in the Epipalaeolithic-Neolithic transition

2. On the significance of plant foods in the daily life of the first Neolithic farmers: ground stone tools and ancient dental calculus reveal insights into cereal and legume consumption strategies during the Pre Pottery Neolithic of the Southern Levant

Andrea Zupancich (1), Emanuela Cristiani (1), Avi Gopher (2), Juan José Ibáñez (3)

(1) Sapienza University of Rome (Italy); (2) Tel Aviv University; (3) Spanish National Research Council, Milà i Fontanals Institute for Humanities Research

In the last decades, numerous studies have explored how the advent of agriculture and the growing reliance on domesticates have affected long-lasting human-plant interactions. In doing so, various pieces of evidence from the archaeological record have been used as proxies to reconstruct the dynamics of plant domestication practices across SW Asia and beyond. In this contribution, we present results from an integrated analysis of material culture and bioarchaeological evidence aimed at reconstructing plant processing strategies and consumption during the Pre Pottery Neolithic in the Southern Levant. By combining the functional study of ground stone tools and the analysis of ancient human dental calculus, we provide novel information regarding the exploitation of plant foods at three archaeological contexts, Netiv Hagdud (PPNA), Kharaysin (late PPNA to middle PPNB) and Nahal Yarmuth (middle PPNB). Our results provide new clues regarding the consumption and processing of plant foods, and in particular legumes. We provide new data about the exploitation of pulses at PPNA and PPNB contexts, emphasising the relevant role that, along with cereals, these plant foods might have played in the life of the first farming communities of the Levant. Furthermore, from a methodological perspective, our study demonstrates how the combination of two different but at the same time strictly related strands of evidence, such as ground stone tools and ancient human dental calculus, can provide relevant clues for the reconstruction and understanding of ancient dietary habits and past human-plant interactions.

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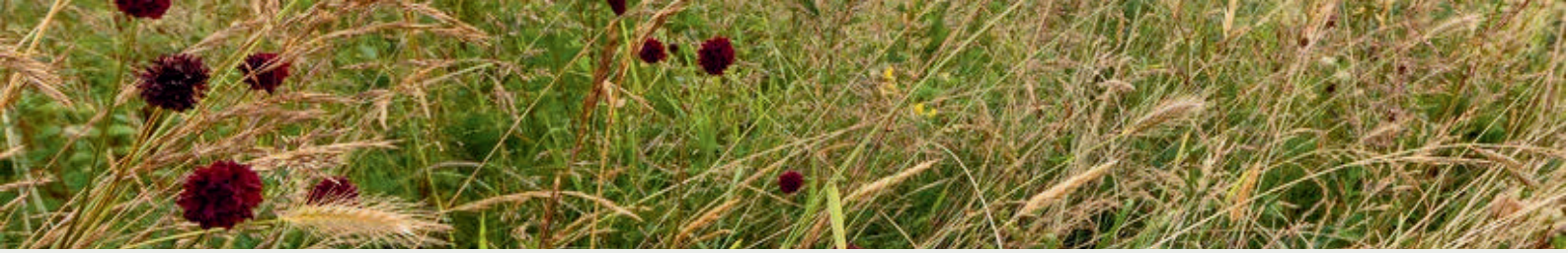
SESSION 3: Plant foods and foodways in the Epipalaeolithic-Neolithic transition

3. What can the Frikeh tell the archaeobotanists?

Hussein Madina (1)

(1) Université Paris 1 Panthéon-Sorbonne

Wheat is one of the most popular cereals in the ancient world, and its archaeobotanical remains are well-documented. Many archaeobotanists have studied it extensively. Numerous food processing products made from wheat -hulled or naked varieties- are well-known in the Levantine region, such as Bulgur, Galiyya, Maftoul, and Frikeh.
Frikeh consists of unripe, milky wheat grain kernels (*Tritium turgidum* ssp. *durum*) that are fire grilled and consumed as snacks or dried for food preparations. This intervention aims to provide more details about the methods of Frikeh production in Jordan and Palestine, primarily by presenting sample analyses from the Marsara village site in Jordan and samples from Ajaa village in Jenin, Palestine.
These modern samples have helped us understand the development of the wheat agricultural economy in the region over time. By comparing modern plant remains from food processing methods with archaeobotanical carbonized remains from many archaeological sites in Palestine, particularly Jericho Hisham's palace samples dating to the Umayyad-Abbasid periods in the 8th century AD, we gain insights into the historical agricultural practices of the region.
This study sheds light on the traditional methods of Frikeh production and their historical roots, offering a comprehensive view of the wheat agricultural economy in Jordan and Palestine. By comparing modern and ancient (archaeobotanical) samples, the research reveals the evolution of food processing techniques and their economic implications, while also highlighting the role of wild plant remains in archaeological contexts.



ABSTRACTS

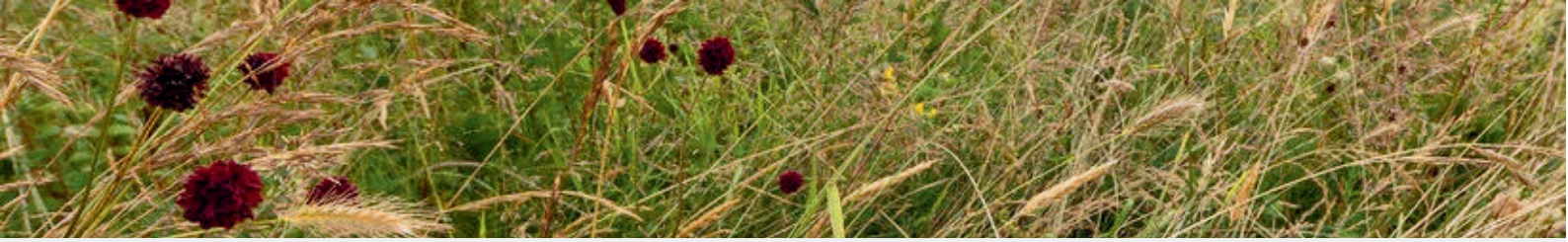
SESSION 4: Genetic and ecological considerations on crop domestication

1. Genomic insights into wheat domestication

Laura Botigué (1)

(1) Centre for Research in Agricultural Genomics (CRAG)

Triticum turgidum was among the first plant species that gave rise to domestic forms in the Fertile Crescent, in a process that started around 11,000 years ago. Wheat domestication has long been studied by an interdisciplinary range of scholars, and the most accepted theory today is that the process of domestication took thousands of years and was geographically diffused. However, the specific contributions of the different wild wheat populations during and after domestication has never been quantified. Here, we investigate the population structure and influence of wild emmer populations from Northern and Southern Levant in the domestication process and the dispersal of the first domestics and its possible role in adaptation to cultivation. We quantify for the first time the genomic proportion of WSL ancestry in two different germplasms including landraces from Europe, Africa and Asia and obtain estimates of the time since admixture of the two wild populations to produce the domestic forms that match the domestication and dispersal towards Africa. We also inquire about the possible adaptive role of wild emmer from the Southern Levant into domestication and dispersal and find an overrepresentation of genes associated with resistance to biotic stress and drought. Finally, we look for these haplotypes in exome capture data we have generated for 2,000 year-old wheat from Egypt to determine whether this signal already existed in ancient wheat. Overall, our work provides more information on the origins of domestic wheat and highlights the potential of modern domestic landraces of emmer wheat in the study of the genetic basis of resilience.



ABSTRACTS

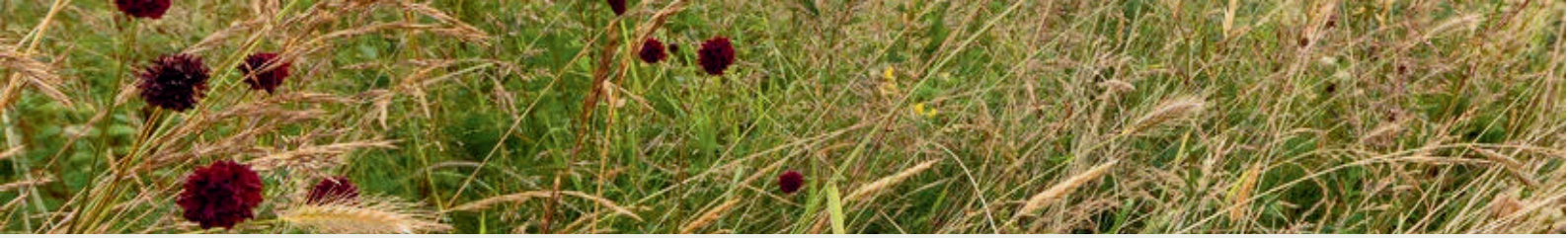
SESSION 4: Genetic and ecological considerations on crop domestication

2. West side story? The possibility of independent prehistoric crop domestication in western Europe

Hugo Rafael Olivera (1), Rui Machado (1), Bernardo Ordás López (2)

(1) Universidade do Algarve; (2) Misión Biológica de Galicia (CSIC)

Agriculture in western Europe (broadly present-day Iberian and Italian Peninsulas, France, and the west of the Elba River) was introduced during the Neolithic and was composed of southwestern Asian crops. The knowledge of cultivation and modification of wild plants might have been applied by these first farmers to locally available plant species or weeds to produce new crops. Cabbage is a putative example.
Here we examine genetic evidence for the local domestications of three crops: opium poppy, oat, and spelt wheat. Three different genomic methods were used to analyse wild and landrace accessions: genotype-by-sequencing (GBS) for opium poppy, DArTSeq for Avena species, and the Breeders' 35K Axiom® array for wheat. We also discuss the caveats of using genomic data of present-day accessions to reconstruct crop domestication, ways to combine genomic with archaeobotanical proxies, and the confounding effect of ferality and de-domestication.



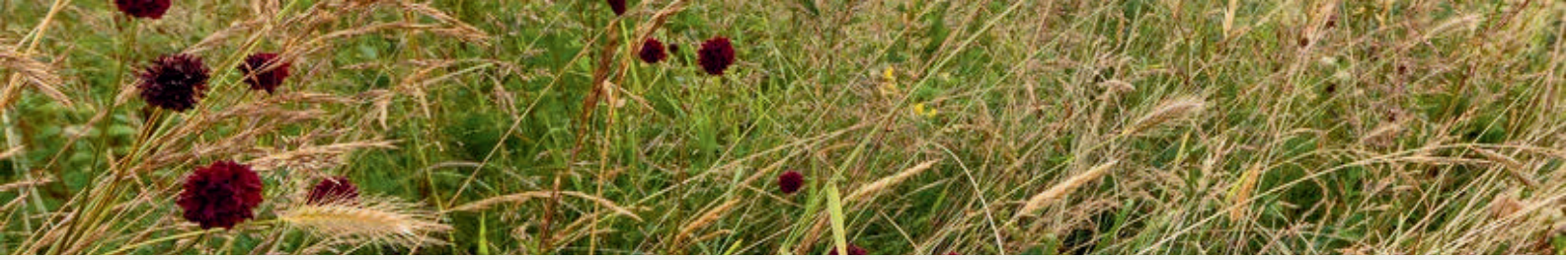
ABSTRACTS

SESSION 4: Genetic and ecological considerations on crop domestication

3. Ancient Grains from Desert Caves Illuminate the Domestication Saga of Wheat

Yael Lev-Mirom (1,2), Nimrod Ashkenazy (1), Valentyna Klymiuki (3), Jennifer Enns (3), Krysta Wiebe (3), Verena J. Schuenemann (4,5,6), Bar A. Lavi (1), Torsten Günther (7), Tamar Krugman (8), Hanan Sela (8), Eitan Klein (9), Amir Ganor (9), Uri Davidovich (10), Roi Porat (10), Erez Ben-Yosef (11), Sivan Frankin (12), Roi Ben David (12), Abraham Korol (2,8), Martin Maschier (13, 14), Axel Himmelbach (13), Nils Stein (13,15), Johannes Krause (16), Assaf Distelfeld (2,8), Ehud Weiss (17), Tzion Fahima (2,8), Curtis J. Poznieak (3), Sariel Hübner (1)

(1) Galilee Research Institute (MIGAL); (2) University of Haifa; (3) University of Saskatchewan; (4) University of Vienna; (5) University of Zurich; (6) University of Vienna; (7) Uppsala University; (8) University of Haifa (9) Israel Antiquities Authority; (10) The Hebrew University of Jerusalem; (11) Tel Aviv University; (12) Institute of Plant Sciences, Agricultural Research Organization; (13) Leibniz Institute of Plant Genetics and Crop Plant Research (IPK); (14) German Centre for Integrative Biodiversity Research (iDiv); (15) Georg-August-University; (16) Max Planck Institute for the Science of Human History; (17) Bar-Ilan University



ABSTRACTS

SESSION 4: Genetic and ecological considerations on crop domestication

3. Ancient Grains from Desert Caves Illuminate the Domestication Saga of Wheat

Despite decades-long extensive studies, the evolution and domestication of wheat remains elusive. To elucidate the evolutionary trajectory of tetraploid emmer wheat, we report the genome resequencing of 16 ancient wheat grains (3,000-6,000-years-old) excavated at caves in the Judean Desert and the Timna Copper Mines in Israel. To elucidate the evolutionary trajectory of emmer wheat, we compared the ancient DNA samples with whole genome sequence (WGS) data of 263 tetraploid wheat accessions. Our results enforce previous indications that the southern Levant is the center of diversity for wild emmer wheat (*Triticum turgidum* ssp. *dicoccoides*), from which it spread to the northern Fertile Crescent. Interestingly, WEW domestication followed a similar geographic trajectory. TtBtr1 haplotype analysis based on the WGS data indicated that the ancestral haplotype from which the non-shattering spike allele (Ttbtr1-B) evolved, has originated in the southern Levant while the final steps of domestication occurred in the northern Fertile Crescent. Later, domesticated emmer wheat (*T. turgidum* ssp. *dicoccum*) split into two lineages: one that spread to Europe and East Asia, and a second that distributed to the southern Levant where a separated southern lineage was established by acquiring introgressions from local wild populations. This distinct ancient southern lineage (older than 6,000 years) was maintained by humans outside the Fertile Crescent through selection which allowed to spread it further to Africa, the Arabian Peninsula (ARB), and eastwards to India. This data provides the earliest evidence for ancient crop improvement following introgressions from wild relatives.

ABSTRACTS

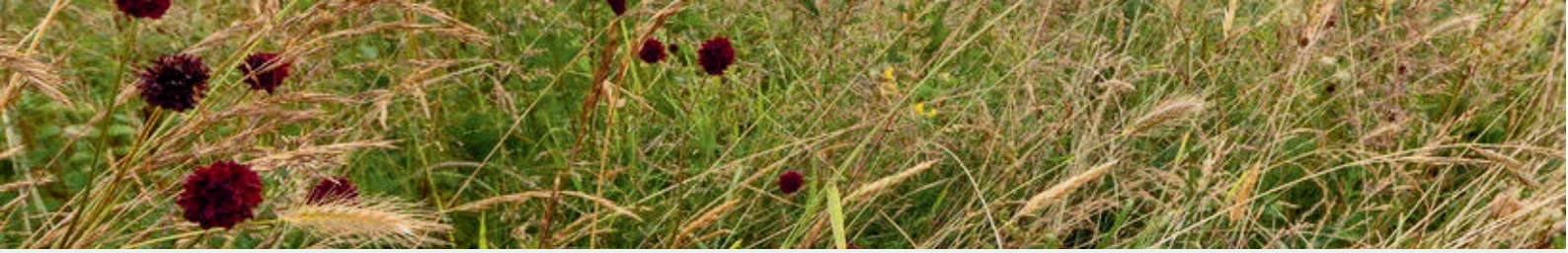
SESSION 4: Genetic and ecological considerations on crop domestication

4. The biology of crop wild progenitors is relevant to domestication traits?

Rubén Milla Gutiérrez (1)

(1) Universidad Rey Juan Carlos

A large portion of the Earth's plant population exists within agricultural ecosystems. In these environments, human influence on eco-evolutionary dynamics is more significant than in any other type of ecosystem. This influence has led to unique evolutionary paths for plants, driven primarily by domestication and cultivation. We have a substantial understanding of how domestication and cultivation have affected specific phenotypic traits important for yield and agricultural management. However, our knowledge is limited regarding the broader consequences of this transition of plants to agricultural settings, particularly concerning plant traits that influence their ecological interactions. In this contribution, we aim to summarize our current understanding of the ecological characteristics of agricultural plants. We explore the various ways in which their evolution under cultivation has impacted the range of ecosystem services they provide. We will highlight the broader ecological consequences of plant domestication and cultivation. This should help to develop sustainable agricultural systems that balance productivity with ecological sustainability.



ABSTRACTS

SESSION 4: Genetic and ecological considerations on crop domestication

5. Evolving weeds and arable ecosystems: three approaches to early weeds

Chris Stevens (1), Leilani Lucas (2), Dorian Q. Fuller (1)

(1) University Colledge of London; (2) College of Southern Nevada

The co-occurrence of weedy taxa, inferred arable weeds, with morphologically wild cereals has been a key argument for early pre-domestication cultivation for more than 20 years since pioneering studies by Colledge, Hillman and Willcox. This remains an active area of debate, yet the study of weedy taxa tends to be more limited than that of cereals and other founder crops. Key questions remain: What was the origin, ecologies and habitats, of arable weeds prior to the first arable fields? To what extent was this weed flora consistent throughout early farming systems across early West Asia? Or is evolving geographical and ecological variation of arable weed floras recoverable?

Presently we know little about ecological shifts and adaptive evolution involved with certain plants transitioning to weeds. We suggest three approaches to addressing this. First, we assess known evidence for seed bank ecology and seed dispersal ecology which affect the likelihood of taxa being resown with crops and harvested with crops. Second, we take a phylogenetic view of ecology, looking at variation in reported soil types and flowering cycles across close congeneric taxa, in reconstructed phylogenies, when possible, thus estimating ancestral ecology and generic plasticity. Third, we can consider co-occurring wild taxa in relation to site catchment to assess the extent of floristic variation with local geological/geomorphic settings. This is applied to an expanded list of 29 early weed genera (after Fuller and Stevens 2019, which expands on the 19 indicators weeds of Willcox 2012).

Fuller, D. Q., & Stevens, C. J. (2018). The Making of the Botanical Battleground: Domestication and the Origins of the World's Weed Floras. McDonald Institute for Archaeological Research. https://www.repository.cam.ac.uk/handle/1810/291135

Willcox, G. (2012). Searching for the origins of arable weeds in the Near East. Vegetation History and Archaeobotany, 21(2), 163–167. https://doi.org/10.1007/s00334-011-0307-1

ABSTRACTS

SESSION 4: Genetic and ecological considerations on crop domestication

6. Ecological processes in Levantine grasslands and arable fields, and how they can help to understand early plant management practices

Alexander Weide (1, 2), John G. Hodgson (2, 3), Ramon Buxó (4), Carolyne Douché (2), Amy Bogaard (2)

(1) University of Cambridge; (2) University of Oxford; (3) University of Sheffield; (4) Museu d'Arqueologia de Catalunya.

Plant functional ecology has been successfully applied to modern and archaeobotanical weed assemblages to inform about different agroecological aspects of cultivation systems. The commonly applied models focus on crop growing conditions in temperate and semi-arid environments along a productivity axis, primarily reflecting soil fertility and water supply. More recently, models that distinguish grasslands from arable fields using traits related to agricultural disturbance added a tool to further disentangle human management practices across past arable and non-arable habitats. However, our results also show that the application of the productivity model may be misleading when applied to modern grasslands, because the trait specific leaf area (SLA) can indicate habitat productivity or adaptation to shade. We show that in some of the sampled Levantine grasslands, SLA indicates self-shading, likely as a function of vegetation density. This is demonstrated by analysing SLA alongside leaf dry matter content (LDMC), which is also related to habitat productivity. In conjunction with disturbance traits, analysing LDMC in addition to SLA represents a further tool to disentangle ecological processes across modern grasslands and arable habitats. We apply the resulting models to early Neolithic archaeobotanical datasets and discuss their potential for understanding early plant management practices.

ABSTRACTS

SESSION 4: Genetic and ecological considerations on crop domestication

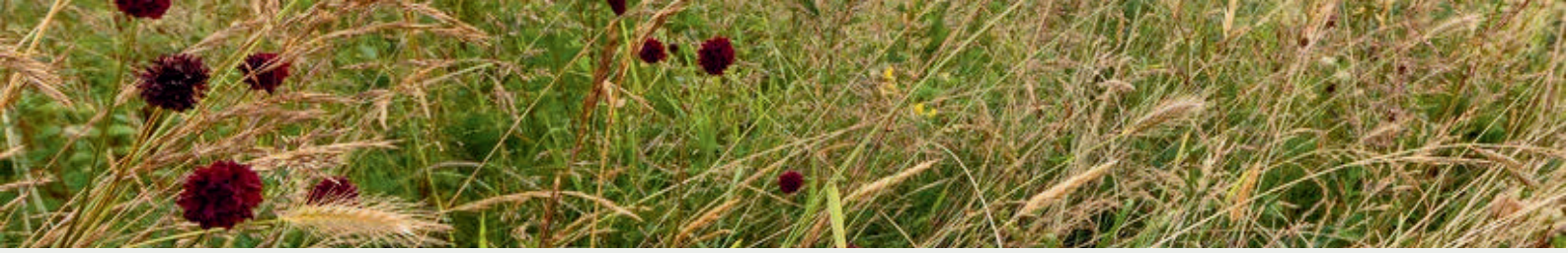
7. Developmental plasticity and genetic selection shaped cereal evolution in the early Holocene southern levant

Jade Whitlam (1, 2), Pascal Flohr (1, 3), Amy Bogaard(1, 4), Mike Charles (1), Bill Finlayson (1) and Cheryl A. Makarewicz (3)

(1) University of Oxford; (2) University of Oxford; (3) University of Kiel; (4) Sante Fe Institute

The domestication of plants in southwest Asia was an evolutionary process that took place over several millennia in the Early Holocene. During this time domestic species developed distinct traits that distinguished them from their wild counterparts. Current models of plant domestication emphasise the role of genetic selection in the evolution of these traits, viewing them as heritable adaptations that arose in response to selective pressures associated with human cultivation. In cereals, domestication resulted in the evolution of non-shattering rachis and increased grain size, two traits that can be tracked directly in the archaeobotanical record. Measurements of cereal grains from Early Neolithic sites indicate that grain size increase occurred prior to the evolution of non-shattering rachis, with selection for larger grains linked to tillage, or other aspects of the cultivated environment, and the presence of large grains at archaeological sites used to support claims of pre-domestication cultivation (PDC).

In this paper, we report on new data from two sites in the southern Levant, PPNA Sharara (c. 9250 cal BCE) and PPNA-LPPNB el-Hemmeh (c. 9100-7000 cal BCE), combining morphological and metrical analysis of cereal remains, single-grain stable carbon isotope analysis, and weed ecological analysis. Our findings indicate that increased grain size in the Early Holocene may be better understood as a plastic response to variation in growing conditions (specifically water availability), than as a result of genetic selection for increased grain size under cultivation (i.e., tillage). We further argue that cereal evolution in southwest Asia was shaped by developmental plasticity as well as genetic selection, and that increased grain size is not a direct function of PDC as traditionally modelled.



ABSTRACTS

SESSION 4: Genetic and ecological considerations on crop domestication

8. The transition to the Neolithic: identifying growing conditions of cereals at Shubayqa 1 and 6 (northeastern Jordan) and Qarassa North (Sweida, Syria)

Jose Luis Araus (1), Maria Dolors Serret (1), Barbara Proserpio (2), Haizea Irastorza (3), Amaia Arranz-Otaegui (2, 3)

(1) University of Barcelona; (2) University of the Basque Country; (3) Sociedad of Sciences Arazandi

The emergence of agriculture represented a landmark in societal development, triggering the Neolithic revolution. The proposed causes behind the transition from gathering to the implementation of agricultural practices are diverse and still open to debate. A worsening of environmental conditions has been suggested as one of the factors triggering this transition. However, the paeoclimatic evidence are generally of a regional nature, which prevents a direct extrapolation with archaeobotanical evidences, which are of a local nature. In this sense, the study of the signature of stable carbon and nitrogen isotopes in plant remains recovered from the sites may allow the reconstruction of the environmental conditions of humidity and nitrogen fertility. We analyzed carbon isotope discrimination Δ13C and nitrogen isotope composition (δ15N) in individual caryopsides of wheat (*Triticum boeoticum/monococcum*) and wild barley (*Hordeum spontaneum*) recovered from the Natufian site of Shubayqa 1, and the late Natufian /early PPNA site of Shubayqa 6 (northeastern Jordan) and the early PPNB site of Tell Qarassa North (Sweida, south Syria). For both species, most Δ13C values of Shubayqa 1 ranged between 14 and 17 ‰ suggesting a quite variable water conditions, including some dry years. At Shubayqa 6, Δ13C values of wheat were placed around 16.5 ‰, whereas for barley values ranged between 13.5 and 16.5 ‰, indicating occurrence of very severe drought episodes. At Qarassa North, most Δ13C values ranged between 14.5 and 17.5 ‰ suggesting a somehow better water status than in the other sites, particularly of barley. Concerning δ15N, both species at Shubayqa 1 exhibited values above 9 ‰, coherent with harvesting in very fertile soils, while at Shubayqa 6 δ15N values decreased 1-2 ‰, particularly for wheat. However, at Qarassa North, δ15N clearly decreased for both species, with most values ranging between 4-6 ‰, coherent with a decrease in soil nitrogen fertility.

ABSTRACTS

SESSION 4: Genetic and ecological considerations on crop domestication

9. How did domestication change wheat morphology and competitiveness?

Yixiang Shan (1) and Colin Osborne (1)

(1) University of Sheffield

Selection under cultivation has caused numerous morphological changes in today's modern wheat varieties compared with their wild relatives. However, the exact timing of these changes and the selection mechanisms involved, have not been determined. Here, we screened morphological traits across a diversity of wild and domesticated wheat varieties to infer the timing of morphological changes, with a focus on domestication, by comparing three independent domestication events. We also conducted experiments and model simulations to investigate the role of competition as a potential selection mechanism. Domestication increased the sizes of wheat leaves and seeds, and made plants grow taller, with more erect architecture. Associated changes to the biomass of domesticated wheats generated more grains and achieved higher yields. Competition experiments showed that domesticated varieties in each case are stronger competitors than their wild relatives. Modelling analysis showed that a number of traits are responsible for this competitive advantage in domesticated crops, including increased leaf size, steeper leaf insertion angle and greater plant height. This implies that natural selection increased the competitiveness of individual wheat plants in the new field environment through changes to canopy morphology. However, strong individual competitiveness has negative consequences for field-scale yields under high modern planting densities. Modern selective breeding has therefore had to reverse these domestication traits by making leaves shorter and more erect, and reducing plant height to improve grain biomass. Our work outlines the shifts in morphological strategy that occurred during wheat domestication, while uncovering the selection pressures behind them. This is an important contribution to our understanding of wheat domestication, as well as to the improvement of agricultural production. It shows that ecological selection mechanisms during ancient domestication events have shaped crop phenotypes for reasons that are irrelevant or detrimental for modern agriculture.

POSTERS

1. Mediterranean deciduous oak woodland opening during the 9th millennium cal BC levels at Kharaysin, Jordan: human-driven or response to climate?

Andoni Mateos (1), Josu Aranbarri (1), Eneko Iriarte (2), Amaia Arranz-Otaegui (1)(3), Juan Muñiz (4), Juan José Ibáñez (5)

(1) University of the Basque Country; (2) University of Burgos; (3) Ikerbasque - Basque Foundation for Science; (4) Saint Esteban Pontifical Faculty of Theology; (5) Spanish National Research Council, Milà i Fontanals Institute for Humanities Research.

The Southern Levant comprises a region particularly susceptible to landscape degradation, since deforestation, coupled to millennial-scale climate variability, brought remarkable changes in pastand modern tree distribution. Long-term wood exploitation, but particularly grazing, superimposed by background arid climate conditions, have led to the destruction of the Mediterranean deciduous oak woodlands, leaving only a few relic stands or isolated trees in less accessible mountain and topographically unsuitable areas. In any case, a noticeable gap regarding past plant biogeography exists in the inner semiarid regions, especially in the Jordanian Highlands.

In this frame, a preliminary palynological and anthracological analyses have been performed in 9th millennium cal BC levels of Kharaysin archaeological site, situated in northwestern Jordan. Overall, the levels dated at the beginning of the 9th millennium cal BC denote a local presence of open, Mediterranean deciduous oak woodland with *Quercus ithaburensis/boissieri* type, *Q. calliprinos* type, *Pistacia*, *Prunus* type and Cuppressaceae as main tree taxa together with xero termophilous shrub understory (*Rosa* type, *Sarcopoterium spinosum*, *Ziziphus*, *Ephedra distachya* type, *Myrtus*, Labiatae). The wood charcoal assemblage shows that the main fuel resources comprised taxa like *Quercus ithaburensis/boissieri* type, *Pistacia* sp. and *Amygdalus*, but other trees like *Ficus* sp. and Salicaceae were also reported in the assemblage. Steppe and desert herb taxa (*Suaeda/Atriplex* type, *Noaea* type, *Artemisia*), some (wild?) cereals (Poaceae >40 µm) and taxa linked to pasturelands (Poaceae <40 µm, *Plantago lanceolata* type, *Achillea* type, *Ambrosia* type, *Centaurea* type, Lactucaceae, *Rumex acetosa/acetosella*) are present in noticeable frequencies. Towards the end of the 9th millennium cal BC, the palynological data reflects a reduction in the arboreal pollen frequencies and the coeval rise in dung fungal spores (*Chaetomium*, *Podospora* cf. *inaequalis*, cf. *Arnium*) most likely linked to increased agropastoral activities.

POSTERS

2. Impact of Morphological Changes During Preservation on Seed and Fruit Identification

Michal David (1) and Yoel Melamed (2)

(1) Ben-Gurion University of the Negev; (2) Bar-Ilan University

Plant remains are crucial for reconstructing human activities and environments at archaeological sites, particularly in aspects of agriculture, trade, and landscape in the Old World. Typically, identifying a higher number of plant species, both domesticated and wild, improves the accuracy of these reconstructions. Identifying a taxon requires determining that the remain resembles its species samples in reference collections.

The preservation state of the remains significantly influences the ability to identify to the species level. Waterlogging and desiccation are two contrasting preservation methods. While waterlogged remains often suffer from soft tissue degradation and compression, desiccated remains are generally well-preserved and show only minor morphological changes. However, some seeds and fruits with dry soft tissues may erode without leaving traces, making remains appear complete but different from their original forms. This can result in misidentification or inability to identify the species.

Examples include the desiccated remains of *Vitis vinifera*, *Erodium hirtum* and *Plantago ovata*, and the waterlogged remains of *Lycopus europaeus* and *Foeniculum vulgare*. To ensure reliable and meaningful identification, archaeobotanists must be aware of these morphological changes and consider them during identification. Consequently, modern computerized 2D and 3D seed atlases should incorporate these metamorphosed remains.

This study highlights the importance of considering morphological changes in seed and fruit remains to enhance the accuracy of species identification in archaeological studies.

POSTERS

3. Elucidating the ecological strategies of crop wild progenitors through trait-based plant ecology

Alicia Gómez-Fernández (1)

(1) Centre d'Ecologie Fonctionnelle et Evolutive

Previous work on the evolution of crop traits has mainly focused on changes that occurred during or after domestication, comparing wild progenitors and cultivated varieties or examining archaeological series across the Holocene. However, we largely ignore which plant traits distinguish wild species that were domesticated (progenitors) from those that were not, and what their ecological profiles are. Here, I propose a conceptual model that integrates crop wild progenitors and other herbaceous species into Grime's CSR plant strategy theory and the global spectrum of plant form and function. This model aims to better understand the phenotypic spaces of both plant types along the economics and size spectra, and to shed light on the ecological strategies of crops' wild progenitors. Through a global meta-analysis and a comprehensive review of studies on physiology, morphoanatomy and archaeobotany, I emphasise that crop wild progenitors show phenotypical traits typical of a ruderal- competitive strategy. This could be due to natural selection caused by the environmental conditions surrounding human settlements (i.e. fertile and disturbed environments) and early human selection on those wild plants that grew fast and produced high yields. Finally, I outline the implications for the origins of agriculture, and recommend future lines of research that would further advance our understanding of crop evolution.

USEFUL TIPS

AIRPORT CONNECTIONS

SAN SEBASTIAN (HONDARRIBIA) AIRPORT TO SAN SEBASTIAN:

BUS/COMPANY: **Bus E21**/Ekialdebus-Lurraldebus (ekieldebus.eus; lurraldebus.eus)
BUS STOP: across the parking, next to the gas station
TRAVELLING TIME: ca. 30-40 minutes
FREQUENCY: ca. 45 minutes
STOPS: Plaza Gipuzkoa, Donostia-San Sebastian

TICKETS: 2,75€
To be purchased directly on the bus (by card or cash)

BIARRITZ AIRPORT TO SAN SEBASTIAN:

BUS/COMPANY: **ALSA BUS** (alsa.es) or **FLIXBUS** (flixbus.es)
BUS STOP: directly at the terminal
TRAVELLING TIME: **ALSA** (ca. 40 minutes); **FLIXBUS** (ca. 1h-1h 20m)
FREQUENCY: **ALSA** (one Bus at 11.40 a.m); **FLIXBUS** (10.55 a.m., 1.00 p.m., 7.40 p.m., 10.30 p.m.)
STOPS: Donostia-San Sebastian Train/Bus station

TICKETS: 7-10€
To be purchased at the airport or online

BILBAO AIRPORT TO SAN SEBASTIAN:

BUS/COMPANY: **PESA BUS** (pesa.net)
BUS STOP: across the parking, next to the gas station
TRAVELLING TIME: ca. 1h 20m
FREQUENCY: every hour
STOPS: Donostia-San Sebastian Bus station

TICKETS: 12-17€
To be purchased directly on the bus (by card or cash) or online

SAN SEBASTIAN TRAIN STATIONS

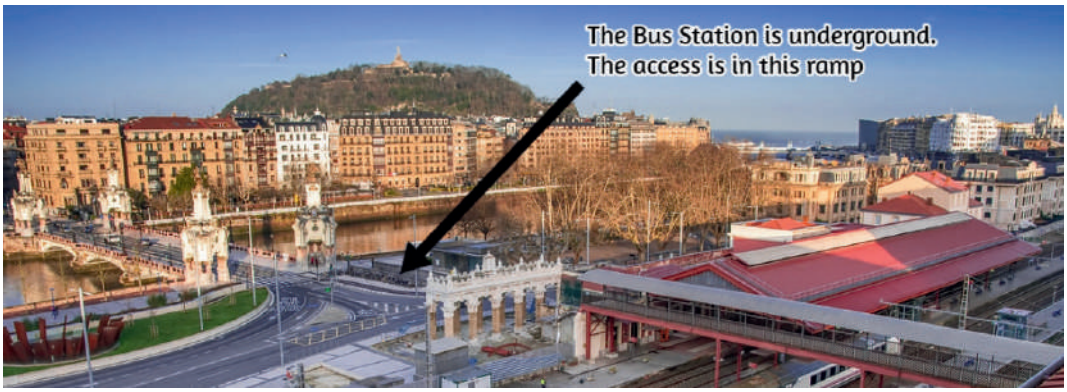
NATIONAL TRAIN AND BUS STATION

- TRAIN STATION: currently under renovation, although it still offers the service.

  CONNECTION: with Vitoria/Gasteiz and Pamplona, from there to rest of inland Spain and France.

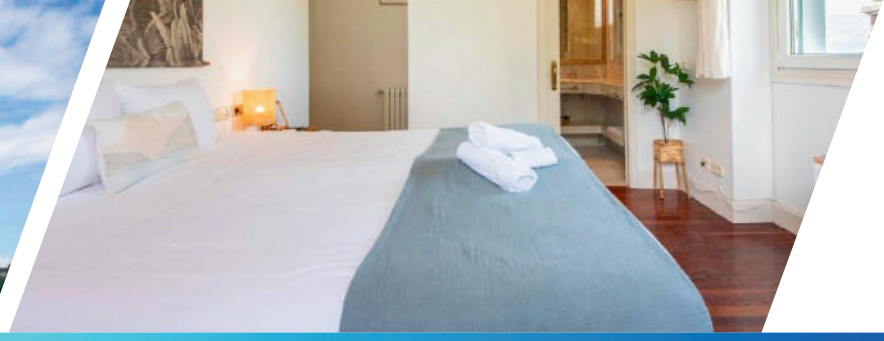
- BUS STATION: The bus station is underground, in front of the train station. The access is through a ramp or an elevator.

  CONNECTION: airports of Bilbao and Biarritz. Main cities around: Bilbao, Biarritz, Vitoria/Gasteiz, Pamplona (pesa.net) and other towns in the province of Gipuzkoa (lurraldebus.eus)



EUSKOTREN

It's a small railway line operating between Irun and Bilbao. From San Sebastian/Donostia it can be useful to visit neighbouring coastal towns like (Pasaia, Orio, Zarautz and Zumaia).



ACCOMMODATION

HOTELS NEARBY ARANZADI

ANOETA HOTEL (ca. 10 minutes walking uphill) (anoeta.hotel.com)

PENSION AMARA (ca. 10 minutes by Bus and 20 minutes walking (pension-amara.es)

HOTELS IN THE CITY CENTRE

SILKEN AMARA PLAZA (hoteles-silken.com)

CASUAL HOTELS (casualhoteles.com)

URBAIA ROOMS (urbaiarooms.com)

TALO URBAN ROOM (talourbanrooms.com)

ZINEMA7 HOTEL (zinema7hotel.com)

GUEST HOUSE IBAIA ET AMARAK (ibaiaetarramak.com)

SERCOTEL EUROPA SAN SEBASTIAN (sercotelhoteles.com)

FAR OUT INN (faroutinn.net)

Pintxos information

The high quality gastronomical offer of San Sebastian is worldwide known, however it is not enclosed into fancy, exclusive restaurants, on the contrary it is widely spread through the city. Whereas some bars have aimed to set the city's gastronomy up to date, some others have kept the exact same offer with an improved quality of the products. Either way, both interpretations of the basque cuisine is legitimated, and it is easily accessible in comfortable small formats called *pintxos*. Some information and recommendations for the best *pintxos* and where to find them is given hereafter:

Txepetxa

This bar is one of those with very retro aesthetic, mirroring past times of the city. Here you will find walls covered with the photos of the many famous actors that visited it during their movies presentation in the film festival and, of course, one of the best made-to-order **marinated anchovies** in town. They come with many and very inventive toppings including blueberries, papaya or foie with apple sauce.

Paco Bueno

More on the classy, retro wooden-bar and white-walls aesthetic, this bar is known for having the best **battered prawns** in the old town.

Bar Sport

Quite far from what the name suggests. This is, again, one of those very traditional, classic bars from San Sebastian serving outstanding food even if it doesn't look like it. Although the most renowned pintxo from Sport is the **grilled foie gras**, they have other delicious ones: give a try to the **rib-eye mini-burger**, the **sea urchin cream**, or the **squid stuffed with crab**.

La Viña

Have you ever heard about the famous **Basque Cheesecake**? Visiting La Viña is a must to taste their speciality and the broadly considered best in town. If you don't have a sweet tooth, you can also try the award-winning **Canutillo**, a surprising made-to-order pintxo with anchovy and cream cheese.

La Cepa

Another old-school pintxo bar serving the classics from San Sebastian. This is a good place to taste many different iberian products among the highest quality, such as **iberian charcuterie** or **cantabric sea anchovies**.

Pintxos information

The high quality gastronomical offer of San Sebastian is worldwide known, however it is not enclosed into fancy, exclusive restaurants, on the contrary it is widely spread through the city. Whereas some bars have aimed to set the city's gastronomy up to date, some others have kept the exact same offer with an improved quality of the products. Either way, both interpretations of the basque cuisine is legitimated, and it is easily accessible in comfortable small formats called *pintxos*. Some information and recommendations for the best *pintxos* and where to find them is given hereafter:

Borda berri

Contrasting with other bars in the old town, this is a low-key modern place serving among the greatest pintxos and portions of the city. Based on traditional basque cuisine, but made into a confortable pintxos and tapas format to try more of it. Of special mention are the **stewed veal cheeks** or the **cod sounds in pil-pil sauce**. However, the menu changes seasonally, so dare to try what's written in the board!

Ganbara

Among the most renowned traditional bars in San Sebastian. It worths a visit to delve into the huge exposition of fresh basque produce at the bar. When visiting Ganbara, don't hesitate ordering the **crab tartelette** or **the mushrooms with egg yolk**.

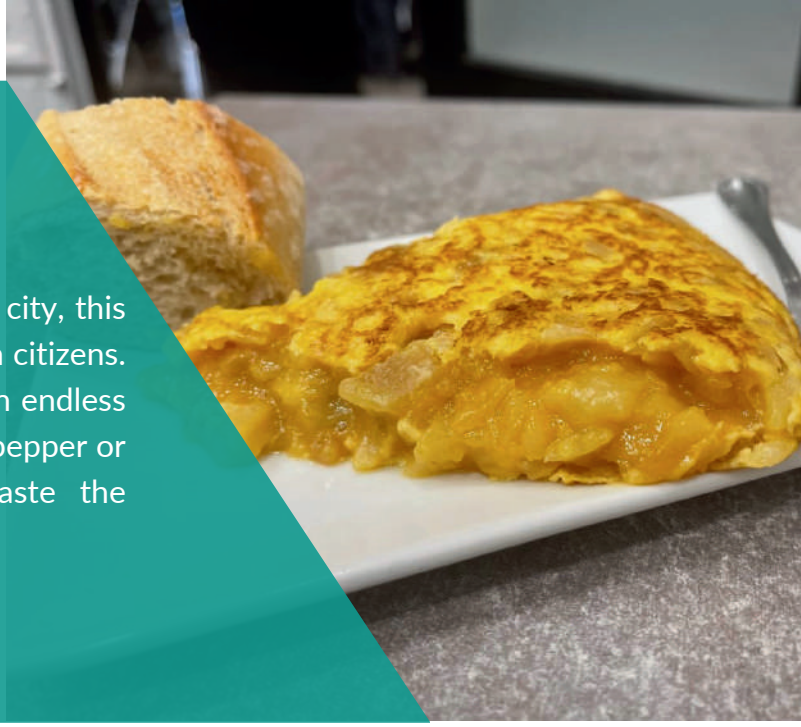
Martínez

Among the best bars of the city. If ordering in this place, ask for the made-to-order pintxos from the kitchen, even though the large bar is filled with delicious pintxos. It's worth trying the **courgette stuffed with crab**, or the **red bell-pepper stuffed with tuna and tartar sauce**, some say it's the best pintxo of the city.

Casa Vallés

Located a little bit outside of the old town, behind the Buen Pastor cathedral, this is also a very old-school bar serving only top quality iberian produce - only need to check the black-labeled iberian hams hanging above the bar to confirm it. If visiting this area of the city, it is highly recomended to try a **Gilda** pintxo (anchovy, green olive and the basque pickled spicy green pepper called 'piparra'), which was invented here and named after the character played by Rita Hayworth in the 1946-movie with the same name.

TORTILLA DE PATATAS / SPANISH OMELETTE



Among the most famous culinary preparations of the city, this is one of the most preferred pintxos for San Sebastian citizens. To find the best tortilla in the city would incur into an endless debate (with caramelised onion or without? with bell pepper or without?), therefore, here are some places to taste the hundred ways of tortilla:

Antonio Bar

Between the old town and the Buen Pastor cathedral - schedule it properly, they only have at midday and around 19pm!

Casa Senra

Gros neighborhood

Bodega Donostiarra

Gros neighborhood

Adamo Beach Bar

By the end of the Zurriola beach, Gros neighborhood

Short trips in San Sebastian

(not organised)

San Telmo museum

Situated in the Old Town of San Sebastian, it is the reference museum for history, archaeology and ethnography of the province of Gipuzkoa. This small museum will tell you about the history of the city and also of Gipuzkoa from the Prehistory to our days, you can also see the San Telmo church holding some impressive frescoes. The museum is in Plaza Zuloaga, and it's open from 10:00 to 20:00, the entry fee is 6€ and with a City Card you will get a 10% discount.

Aquarium

The aquarium in San Sebastian is the oldest Marine Natural Science museum in Spain, inaugurated in 1928 it is situated in a staggering corner of the Old Town overlooking the bay and the Old Harbour. The entrance fee is 14€ and it includes a discount if you are the holder of a City Card. It's open during the week 10-19h and 10-20h on weekends.

Basque Maritime Museum

Situated in the Old Harbor, just 50m away from the Aquarium we find the Basque Maritime museum. The building represents one of the few survivors of the 1813 fire; it once held the San Sebastian consulate. Here you will learn about the development of the old harbour, the historic commercial relevance of S.Sebastian and about the basque fishing industry. The entrance fee is 3€, it's open Tuesday to Saturday 10-14h/16h-19h, and 11-14h on Sundays.

Short trips in San Sebastian

(not organised)

Igeldo mountain

Igeldo amusement park opened to the public in 1912 and it's among the oldest in Spain. This small park has some of the best views of the city, together with the enchanting old fashioned rides and the funicular taking you from the beach to the top of the mountain, makes it an unforgettable experience. The funicular runs every 15min between 10:30-21:00h and the way and return ticket costs 4,5€ https://www.monteigueldo.es/home.

You can take a 30min stroll from the centre to the funicular station walking along the beach, don't forget to visit the iconic Peine de los Vientos by Chillida at the end of the promenade.

Mount Urgull

This is the mountain over the Old Town, where the old fortress of the city and the Christ sculpture are situated. It's currently a park, only closed at night, it has several entrances. The only downside is that the way to the top is quite steep, so take it easy! You will be rewarded with the views, and can take a drink in the 'Urgulleko polboriña'' bar.

Day trips
(not organised)

Hondarribia

One of the most beautiful coastal towns in the Basque Country. This border town has loads of history, founded in the XIII century as a military outpost, it still preserves a rich cultural heritage, making it a top tourist destination. Most remarkable areas are its walled old-town overlooking the Bidasoa estuary and the fishermans' quarter filled with bars and restaurants. Its manageable size makes it a good destination for a day or morning trip, as one can see most of the highlights within a few hours.

To reach Hondarribia one can take the E21 bus in the city center (Gipuzkoa Plaza), it runs every hour and also stops in the S.Sebastian airport (Ekialdebus or Lurraldebus, it's the same service).
https://ekialdebus.eus/es/linea-e21-aeropuerto-hondarribia-donostia/
https://www.lurraldebus.eus
The cost of the ticket is 2,75€, it can be bought directly in the bus by card and the travelling time is around 30-40 min.

Day trips
(not organised)

Albaola museum

Albaola is a museum and shipbuilding factory promoting basque fishing and shipbuilding heritage. Currently they are building a replica of the XVI century whale fishing ship 'Nao San Juan' using local oak wood and traditional techniques and tools. The shipwreck was found in 1978 in Newfoundland (Canada), its voyage and sinking were traced back thanks to historic archives. The construction of the replica started in 2016, and it's expected to be finished by the end of this year.

The museum is in Pasajes San Pedro, and it is possible to take a small boat across the bay to visit the colourful Pasajes San Juan. To reach San Pedro take the E09 or E08 in Calle Okendo 16 (City centre), the bus runs every 15mins and it's the last stop, it takes 15min (https://www.lurraldebus.eus). The entrance fee is 10€ and a City Card offers you a discount, its open 10-14h on Tuesdays and Sundays, and 10-14h/15-18h from Wednesdays to Saturdays https://albaola.org/

Day trips
(not organised)

Getaria/Zumaia

Getaria is a small town, birthplace of Juan Sebastián Elkano first sailor to complete the first circumnavigation of the Earth 500 years ago, and of the fashion designer Cristobal Balenciaga founder of the worldwide famous clothing brand. The town is also known for its popular white wine 'txakoli', essential in the fresh fish roasting restaurant menus in the town. To know more about the fashion designer one can visit the Balenciaga Museum https://www.cristobalbalenciagamuseoa.com/.To reach Getaria take the bus UK10 (https://www.lurraldebus.eus) at Avenida de Libertad 3 (city centre), it runs every hour and the journey is takes around 40min. The same bus continues its journey all the way to Zumaia, which is 10 minutes further than Getaria, so in a day both towns can be visited.

Zumaia is well known for the Basque Coast geopark, a stretch of 13kms of coast exposing a geological record of more than 50 million years of flysch formation between the Cretaceous and the Paleogene. There are various routes along the coast and even guided boat trips to learn about these outstanding geological outcrops https://geoparkea.eus/es/.

PALAEORIGINS

Tracing the Epipalaeolithic origins of plant management in southwest Asia

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